

Coastal Vulnerability Analysis: Brunswick and Harpswell

Krista Bahm, Maryellen Hearn

Melissa Anson, Liza LePage, Tom Marcello, Woody Mawhinney, Leah Wang,
Phil Camill, Eileen Johnson

Bowdoin College
Environmental Studies
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Project Goals

- Address State of Maine Climate Adaptation Plan
 - Analyze coastal vulnerability and sea level rise in the towns of Brunswick and Harpswell
- Develop a simplified methodology that can be replicated in other coastal communities
 - 85% of New England coastal communities have a population of 50,000 or less

Address State of Maine Climate Adaptation Plan, “People and Nature Adapting to a Changing Climate.”

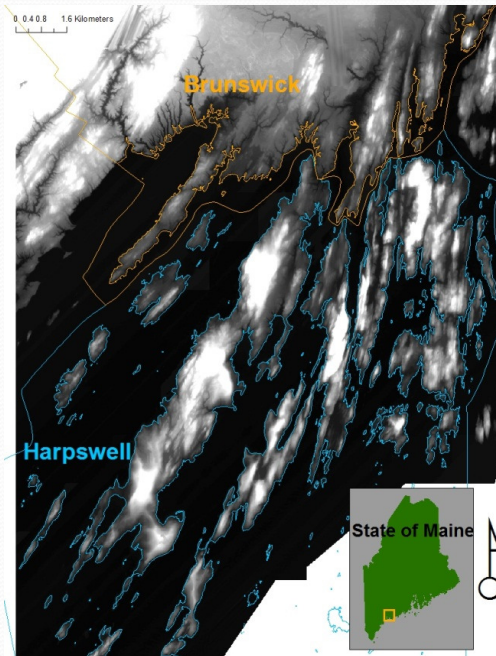
Perform a preliminary analysis of coastal vulnerability and sea level rise in the towns of Brunswick and Harpswell.

Develop a methodology that can be replicated in other coastal communities.

Communicate our findings to the town residents, town officials, and state planning.

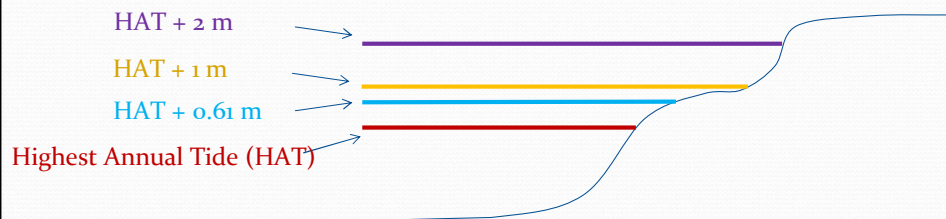
Study Region

Light detection
and ranging data
(LiDAR):
provided by
FEMA, 2006



Sea Level Rise Scenarios: 2100

- 0.61 meters (2.00 feet)
- 1.00 meter (3.28 feet)
- 2.00 meters (6.56 feet)



Based on predictions by MDEP (coastal sand dune rules, chapter 355), IPCC, Maine SPO, and EPA.

HAT calculated for Cushing Island b/c it was the nearest station that said on the Tides and Currents site that it recorded in NAVD88, calculated using the MGS Tide Calculator



Categories of data analysis:

- Land
 - Acreage
 - Parcels
 - Valuation
- Infrastructure
 - Buildings
 - Roads
 - Piers
- Marshes

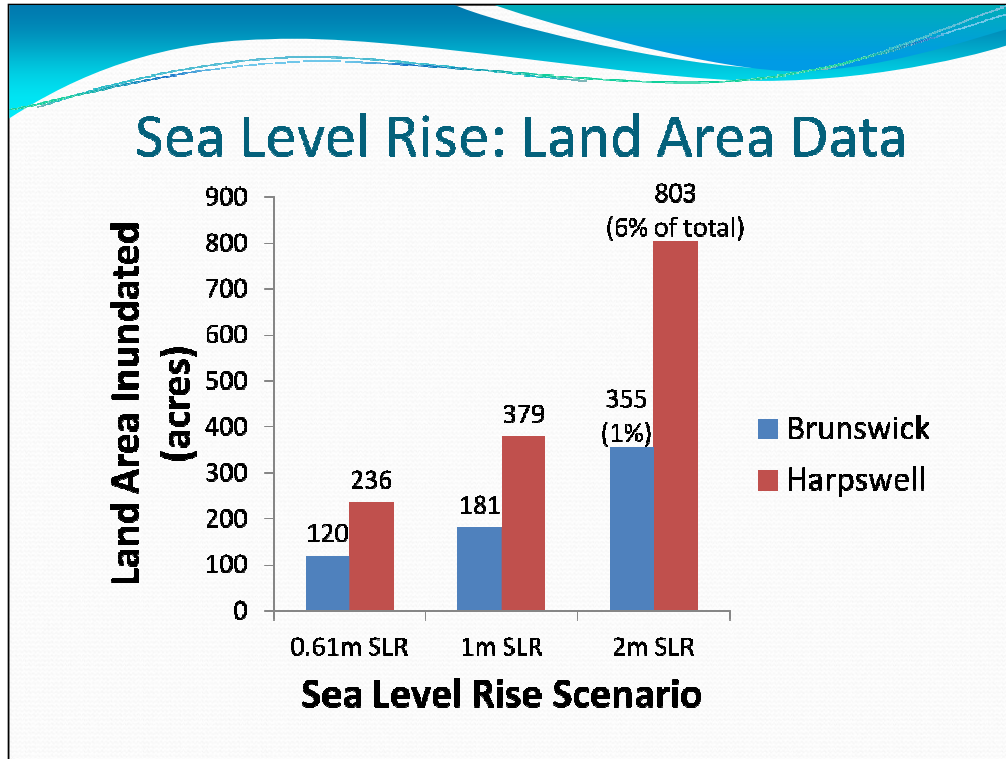
For the remainder of the presentation we're going to dive into the data and present the analysis we've completed for Brunswick and Harpswell specifically. For the sea level rise and storm surge scenarios we have decided to group our data analysis into various categories including: land, buildings, population, infrastructure and marshes



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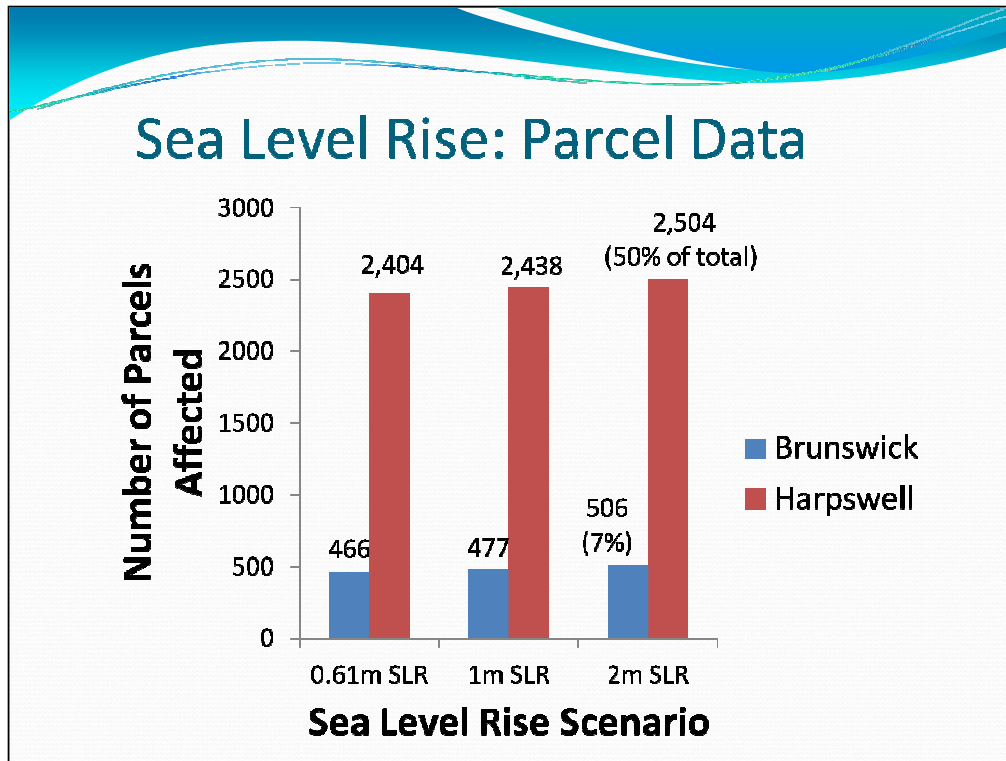
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Main Point: Acreage inundated increases dramatically with greater sea level rise

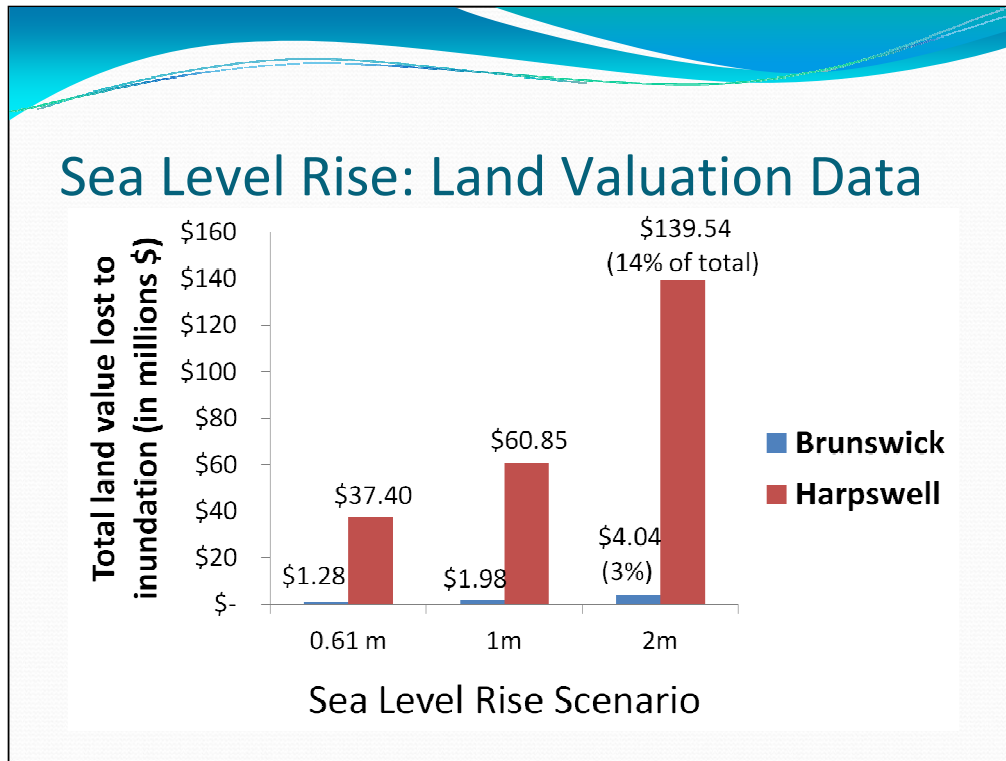
Updated

This graph, is representative of SLR graphs you will be seeing throughout the presentation. Note that horizontal axis depicts each of our 3 sea level rise scenarios. The vertical axis is scaled to show the percentage of total acreage inundated. Brunswick is represented by the blue bars on the left and harpswell will always be represented by the red bars on the right. From this graph we can see that between .3% and 1% of Brunswick's total acreage is inundated under the SLR scenarios. In Harpswell between 1.6% and 5.5% of total acreage is inundated. This gives you a sense of the scale of affected areas.



Main Point: The parcels affected do not increase significantly due to greater SLR, meaning many of the same landowners will be affected, more severely

Still looking at SLR we broke down our land analysis in terms of parcel data we received from the town offices. On the horizontal axis are the SLR scenarios. And on the vertical axis lies a scale of percentage of total parcels affected. An important note on terminology, we use the word “affected” to mean that a parcel has been touched by water due to SLR. We can see that in Brunswick, the blue bars show us that in each scenario around 7% of the parcels in the town are affected. Looking at the red bars, Harpswell, we see that around 50% of the total parcels are affected. This analysis is important because it tells us that although more land area is inundated under increasingly greater SLR the number of parcels does not increase much.



Main Point: Land value lost to inundation substantial and an important consideration for tax assessment and revenue

METHODS:

Tax assessors value land based on lot size, current market prices, and neighborhood characteristics

Obtained current parcel values from town offices, and joined this with our sea level rise inundation data

Assumed a linear relationship between value and acreage

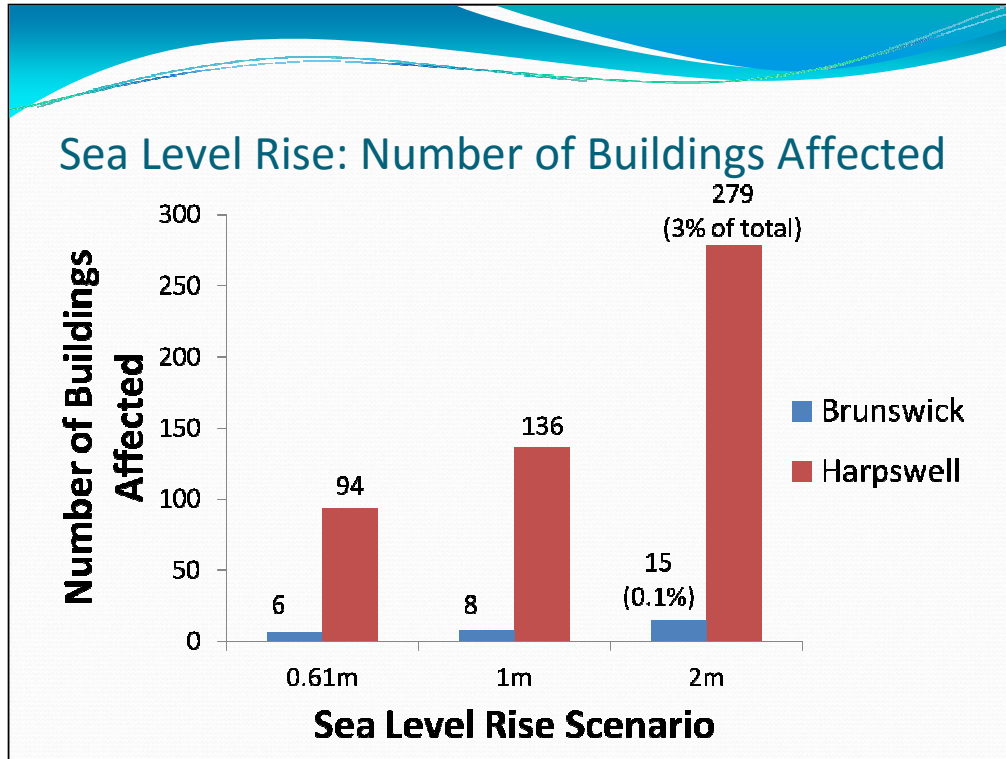
Estimated the total land value lost in each SLR scenario for Brunswick and Harpswell



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Main Point: Although these percentages do not appear large, keep in mind this is the number of buildings that will be touched by sea level rise but a greater number of buildings will become structurally vulnerable due SLR

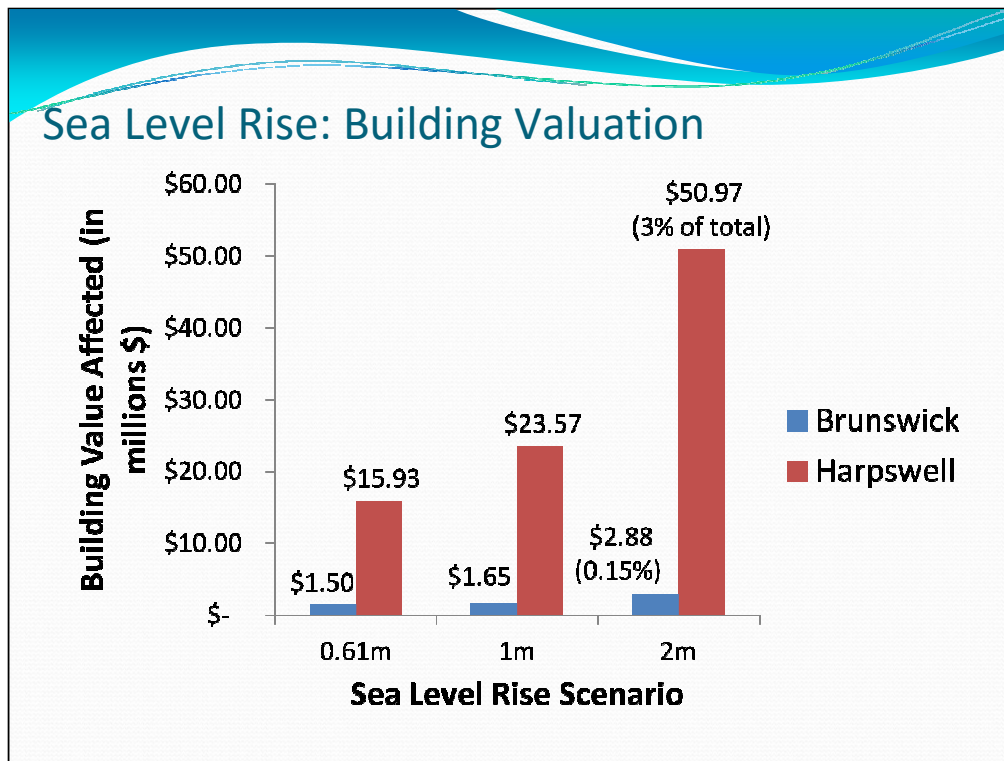
Methods:

Building data combined with parcel data from the town tax assessors to attribute a 'use type' to each building

If water touches part of building, deemed "affected"

To determine valuation: the total tax assessor value of "improvements" to the land were added for all affected buildings

How many buildings will be affected by SLR?

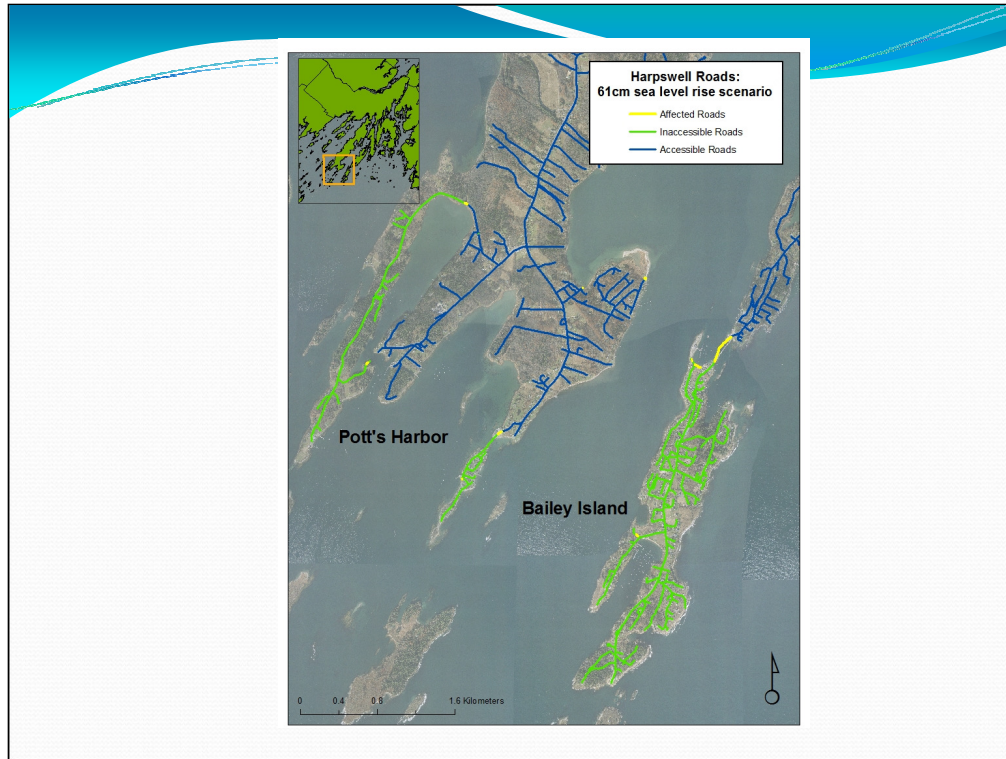


Main Point: The value of building affected but also requires money to repair

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- Marshes

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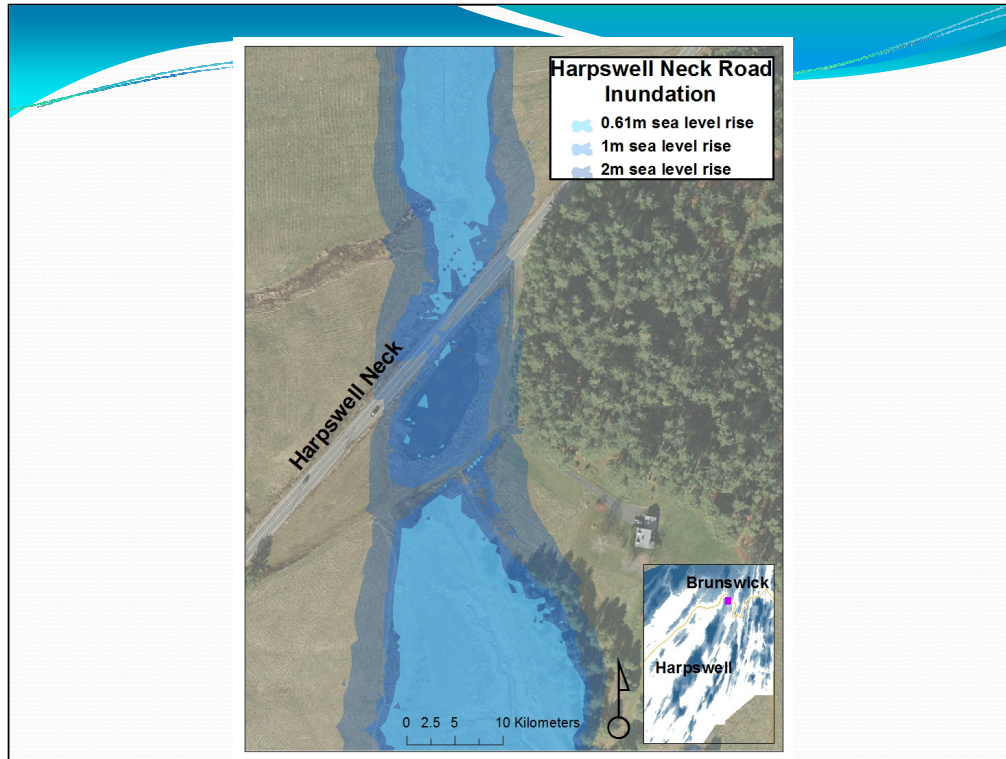


Main Point: Significant road mileage will be cut off from the mainland due to SLR

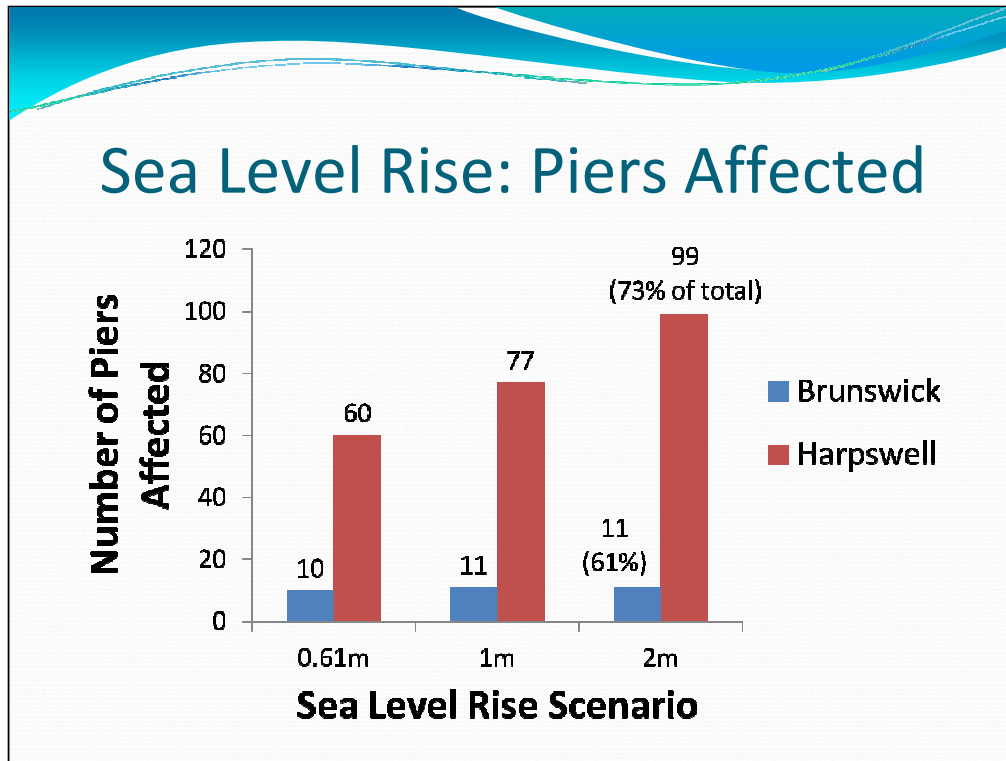
METHODS

Mapped E911 roads and determined elevation of roads using LiDAR data
Observed inundated sections of roads

Will communities become isolated due to SLR?



Main Point: 10km/20km of water, substantial inundation that will be impassable. Also water reducing structural integrity of roads (ex. 0.61m)



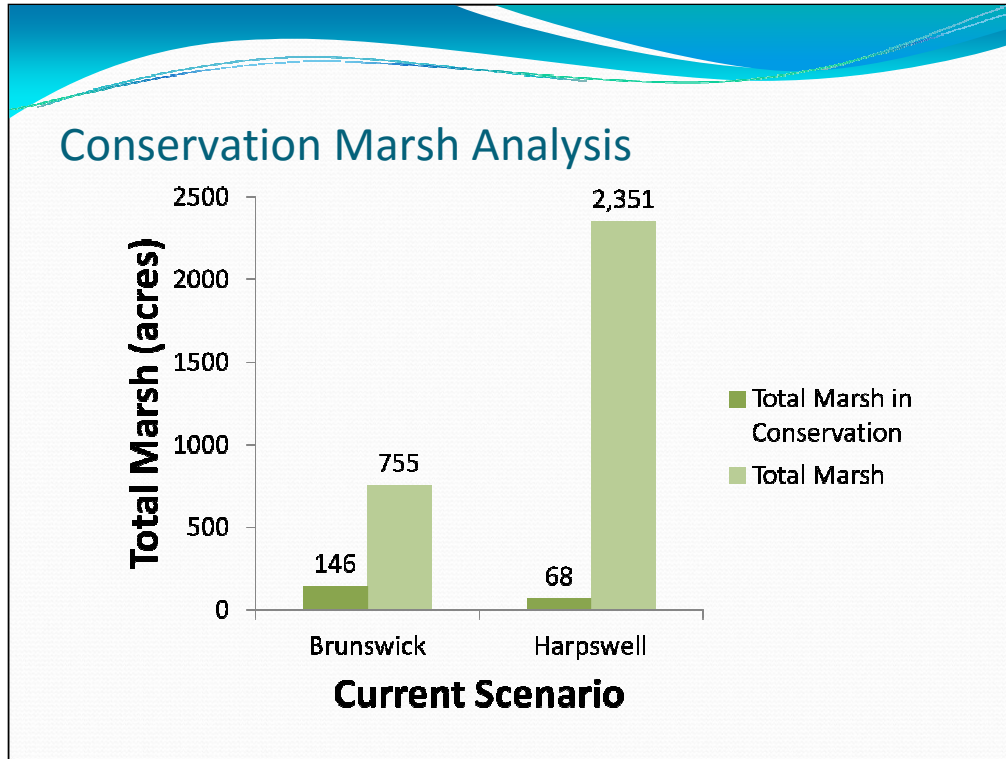
Main Point: Piers are important for livelihoods and will be greatly impacted



Categories of data analysis:

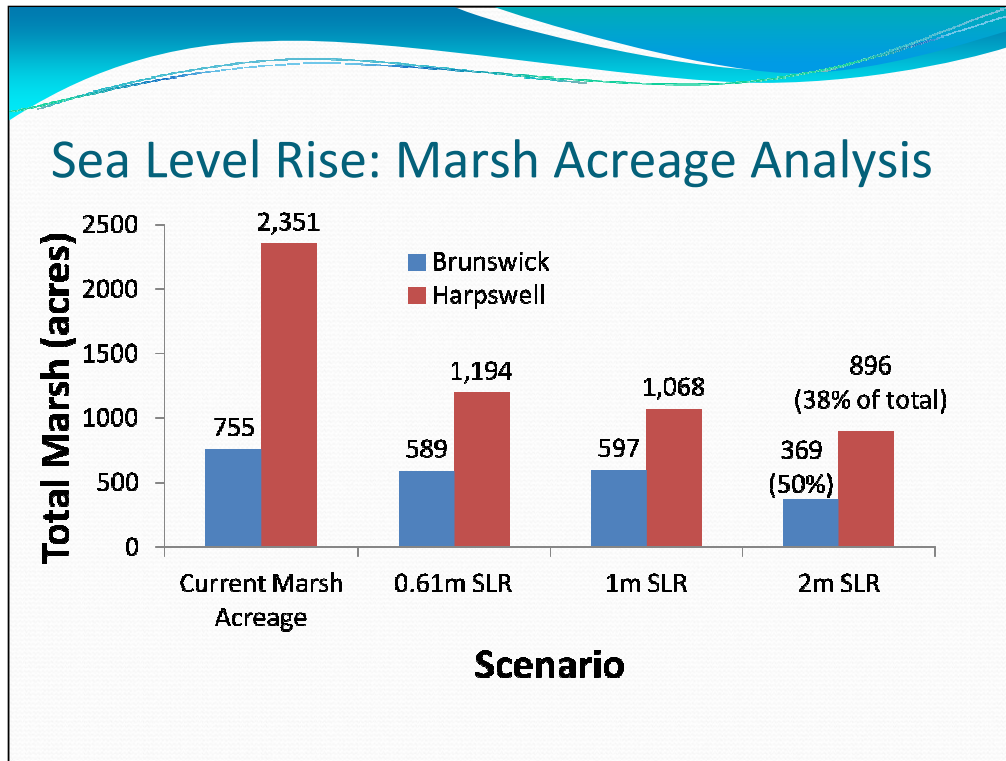
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Main Point: Not much conservation marsh

Here is part of our ownership analysis. On the y-axis we're seeing the number of acres 'affected' or becoming marsh under the different SLR. Orange designates public ownership, or town-owned parcels, or land trust easements that have public access. Purple is all other privately-owned open space. And there is a large effect on these parcels. An example of how to react to these changes is to encourage private landowners to move to higher levels of conservation of their land, like easements. The tax programs that exist for open space, while they create incentives to keep land as such, can be changed at any time for development, while an easement is a stronger agreement.



Main Point: Marsh Acreage decreases significantly with rising sea levels

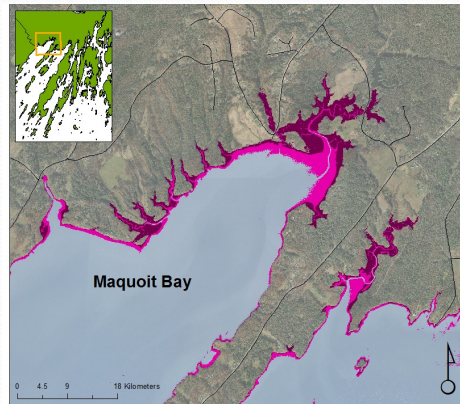
Where will low and high marsh be found after sea level rise?

How is conservation land affected by the shift in marsh location and area?

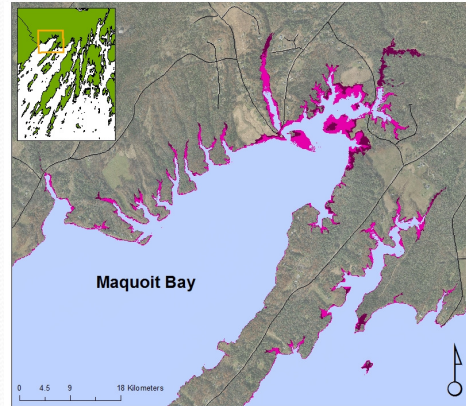
Why is open space important in preparing for climate change and SLR?

We found that in both Brunswick and Harpswell, marshes did begin to creep up onto the upland area of open spaces. Here we see that around 50 acres of open space in Brunswick, and over 60 acres of open space in Harpswell became part of a marsh ecosystem under 2 meters of sea level rise.

Marsh Analysis: Maquoit Bay



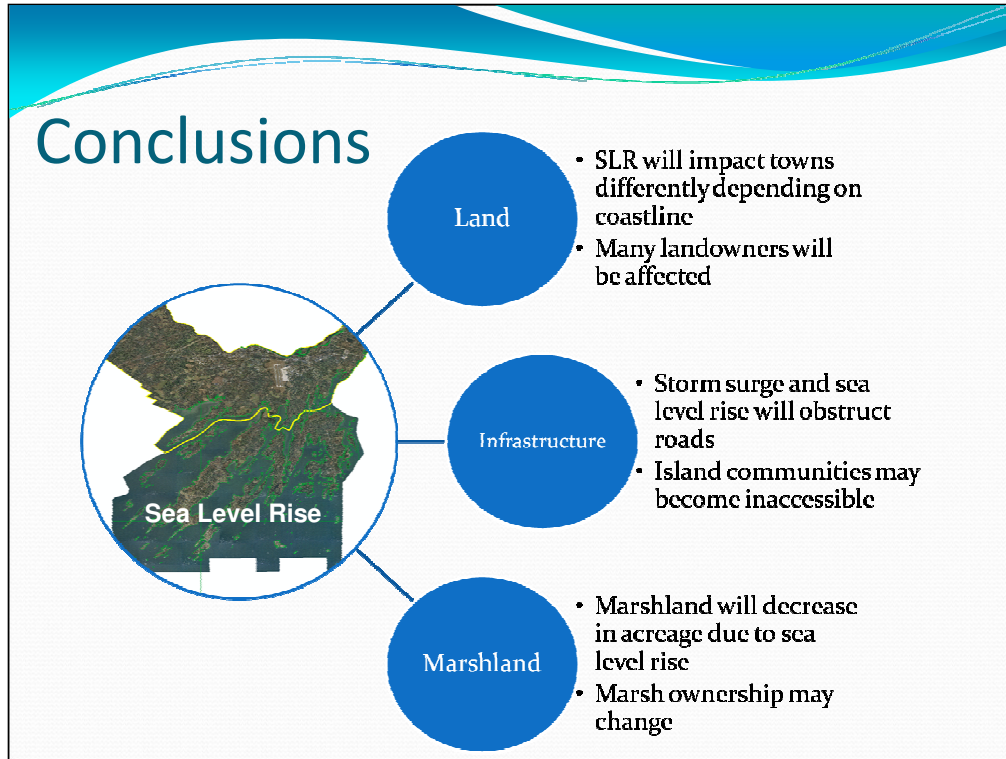
Current Scenario



2m SLR Scenario

Dark magenta: High Marsh
Light magenta: Low Marsh

Main Point: Visual representation of decreasing marsh acreage



Even though both of these towns have rocky coastlines sea level rise will cause substantial damage to town economies, livelihoods, infrastructure and ecological communities. Methodologies such as this, although not simple, can be completed with minimal town resources on a local scale. Also, we suggest that data consistency and availability on a local and sub-state level will be essential for further studies. Any questions?



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- Bowdoin College Information Technology
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- Steve Dickson, Maine Geologic Survey
- Doug Marcy, NOAA
- Pete Slovinsky, Maine Geological Survey

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Storm Surge Analysis

Portland Storm Surge
Height Frequency

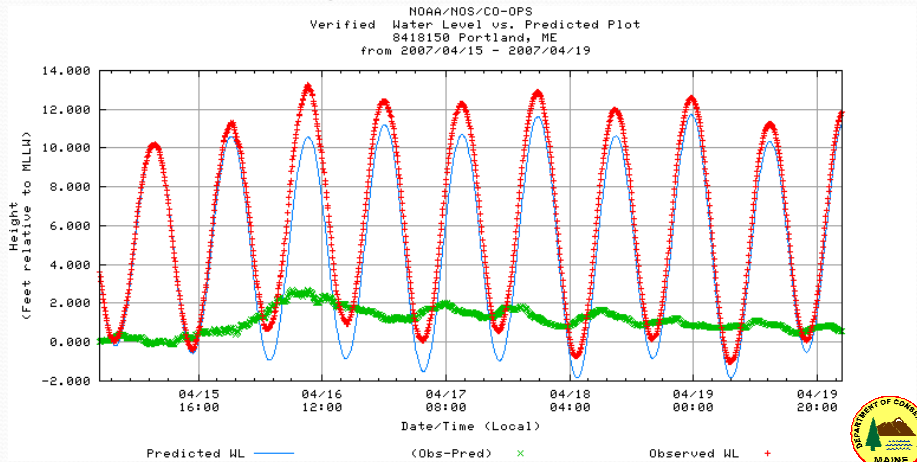
Surge (ft)	Ave. Occurrence (yrs)
3.0	4.5-7
3.5	10-14
4.0	22-49

- Record surge at
Portland: 4.3 feet

Rise (ft)	MHHW (ft)	MHHW + 3.0 (ft)	MHHW + 4.3 (ft)
None	4.59	7.59	8.89
2.00	6.59	9.59	10.89
3.28	7.87	10.87	12.17
6.56	11.15	14.15	15.45

Storm Surge Analysis

- What is storm surge?

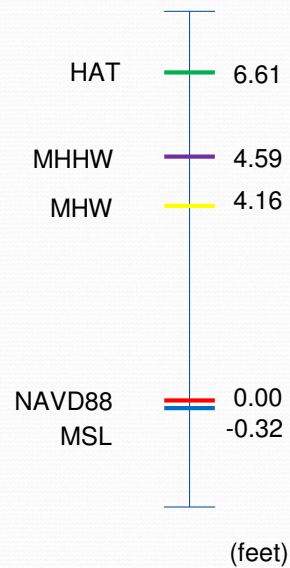


Storm surge is green, the observed-predicted, therefore, in modeling SS we added the SS onto MHHW as it is more likely to coincide with MHHW than HAT
Storm surge can be associated with low pressure systems, high winds pile up the water so it is higher than predicted sea level

Sea Level Rise

How do we map sea level rise?

- Highest Annual Tide
- Mean Higher High Water
- Mean High Water
- North American Vertical Datum
- Mean Sea Level



I think we should have a discussion about the 2.00 vs 2 ft thing...

1995 Executive Summary for sea level rise planning for Maine, published by U.S. EPA in cooperation with Maine State Planning Office

NRCM is analyzing 6 meter SLR potential impacts

IPCC says 66cm is most likely, 1m and 2m come from EPA/MEStatePlanningOffice

Sand Dune

Visualizing the Marsh Shift

- How does the acreage of high marsh shrink?

